

Place de l'océan dans les rapports du GIEC et les conférences climat



Jean-Pierre Gattuso

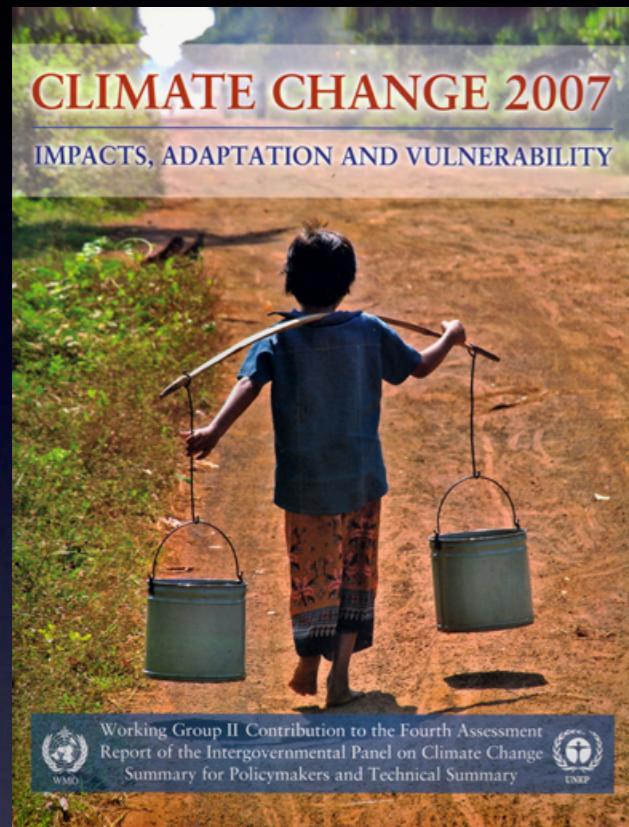


Les Rencontres
scientifiques d'AllEnvi

La RECHERCHE et les OBJECTIFS
de DÉVELOPPEMENT DURABLE

IPCC coverage of ocean impacts

2007: AR4



- C6: Coastal systems

2014: AR5



- C5: Coastal systems
- C6: Ocean systems
- C30: The ocean
- Ocean reprint package
- Ocean web site

Special reports

IPCC
Special Report on
impacts of global
warming of 1.5 °C
above pre-industrial
levels and related
global greenhouse
gas emission
pathways

[Published October 2018]

IPCC
Special Report on
Ocean and
Cryosphere in a
Changing Climate

[Published Sep. 2019]

2021-2022: AR6

WGI:
Ocean, cryosphere,
and sea level change
+ ...

WGII:
Ocean and coastal
ecosystems and their
services
+ Regional chapters

[Published October 2018]

Occurrence of 'ocean'
x2.5 in AR5 SPM than in
AR4 SPM

COPs: multitude d'acteurs

Global Ocean Forum

Promotes good governance of the ocean, sustainable development for coastal and island peoples around the globe, and healthy marine ecosystems.

PML

Plymouth Marine Laboratory

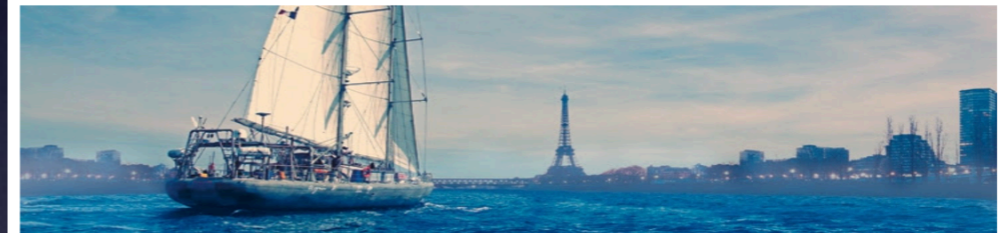


Ocean & Climate platform

Un océan en bonne santé, un climat protégé

“Because the Ocean” declaration

For the first time in Paris this week 22 countries have raised prominently the Ocean at a Climate COP, indicating that we are ready to enter a new era of climate action that includes the planet's blue part which represents 75% of the Earth's surface. The ocean absorbs 25% of CO₂ emissions and 90% of the heat associated with climate change, recognition and inclusion in the climate debate is long overdue.



OCEANS 2015 INITIATIVE



Ocean Acidification
International
Coordination Centre
OA-ICC



**FONDATION
BNP PARIBAS**

The Ocean Solutions Initiative



Ocean Acidification
International
Coordination Centre
OA-ICC



**PRINCE ALBERT II
OF MONACO
FOUNDATION**

COPs: multitude de side events



Global carbon budget (2007-2016)

33.4 Gt CO₂/yr (88%)



+

4.8 Gt CO₂/yr (12%)



Global carbon budget (2007-2016)

33.4 Gt CO₂/yr (88%)



+

4.8 Gt CO₂/yr (12%)



Atmosphere
46%



Vegetation
30%

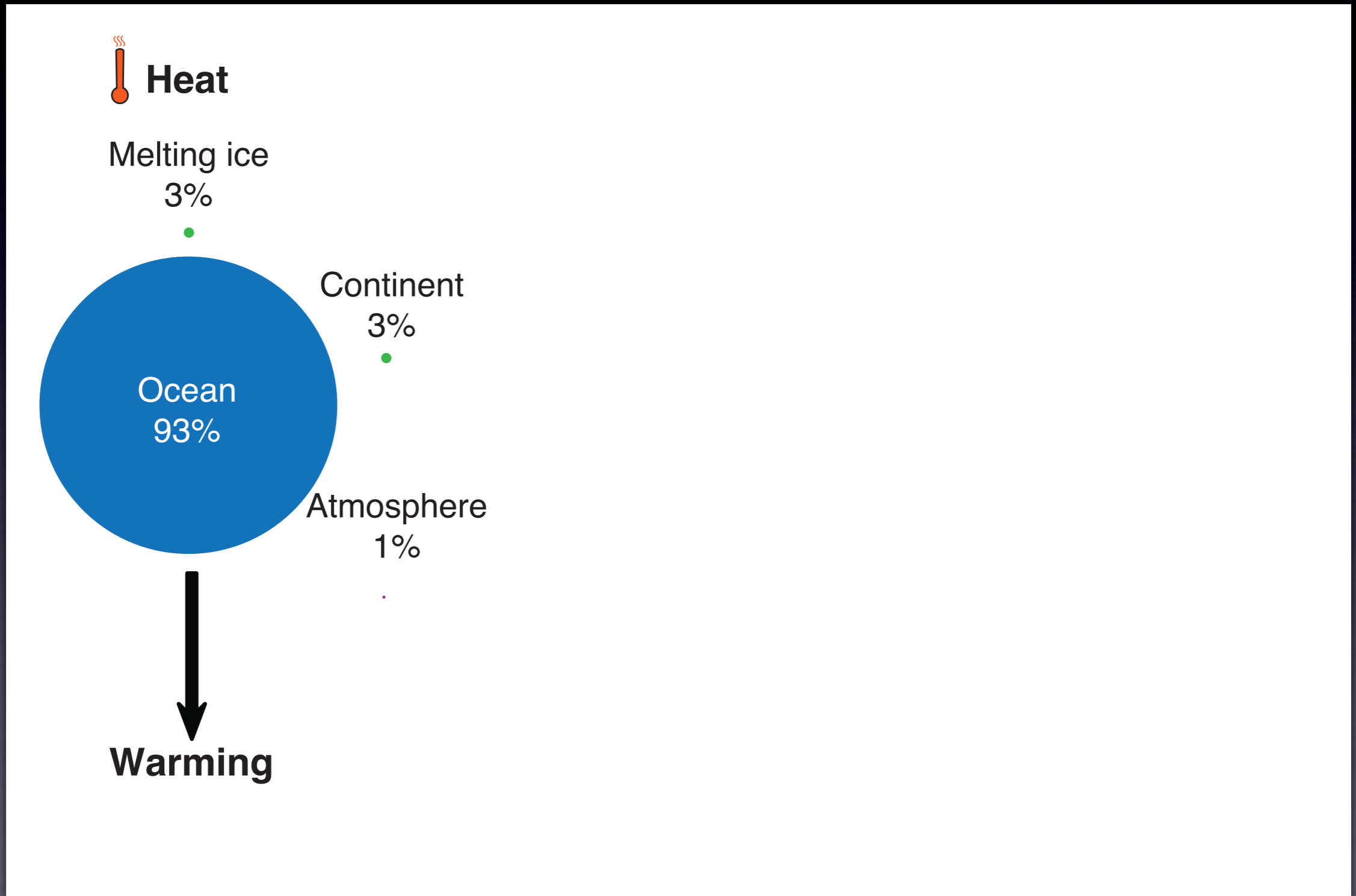


Oceans
24%

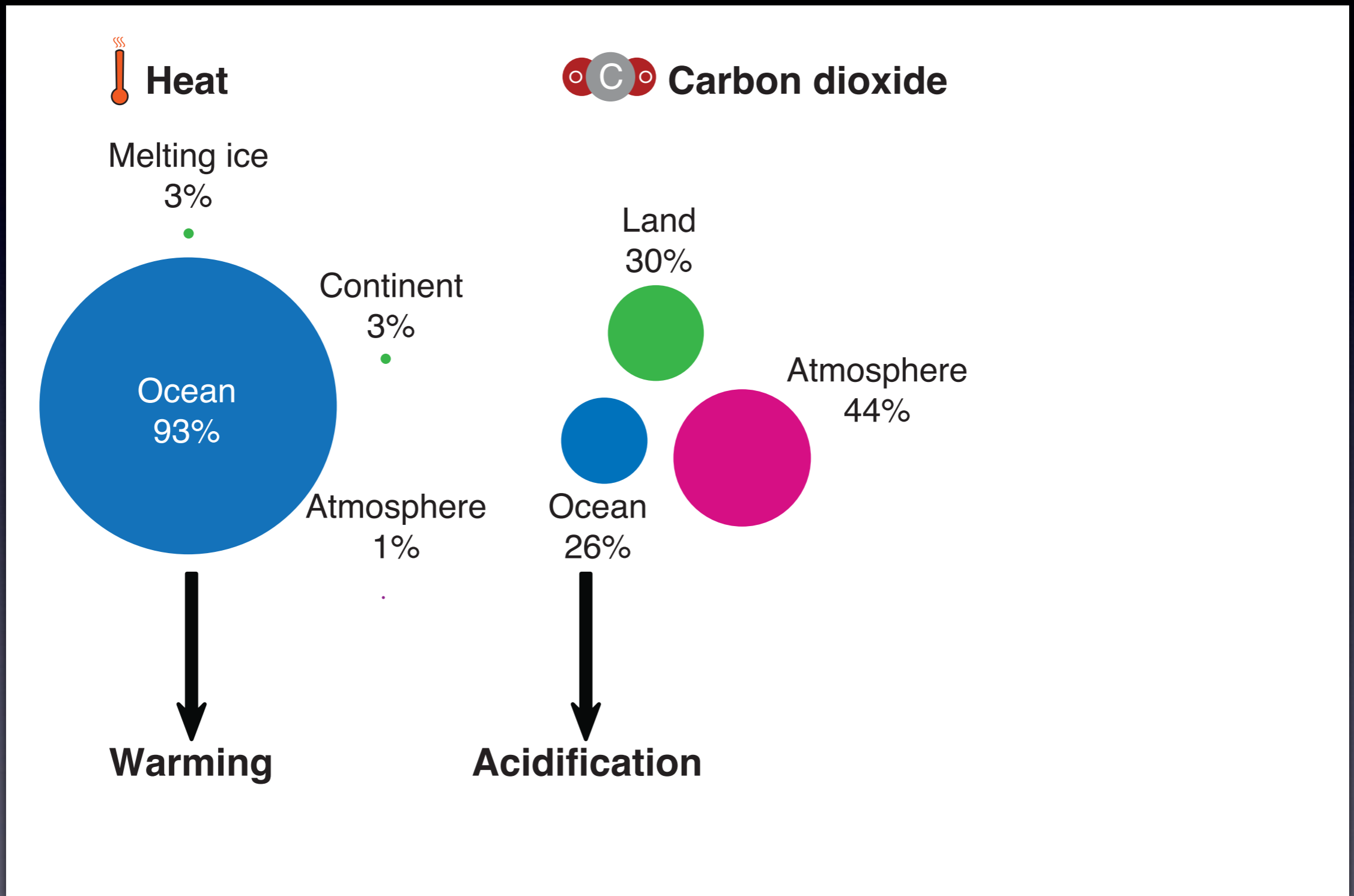


30 millions tonnes CO₂
per day

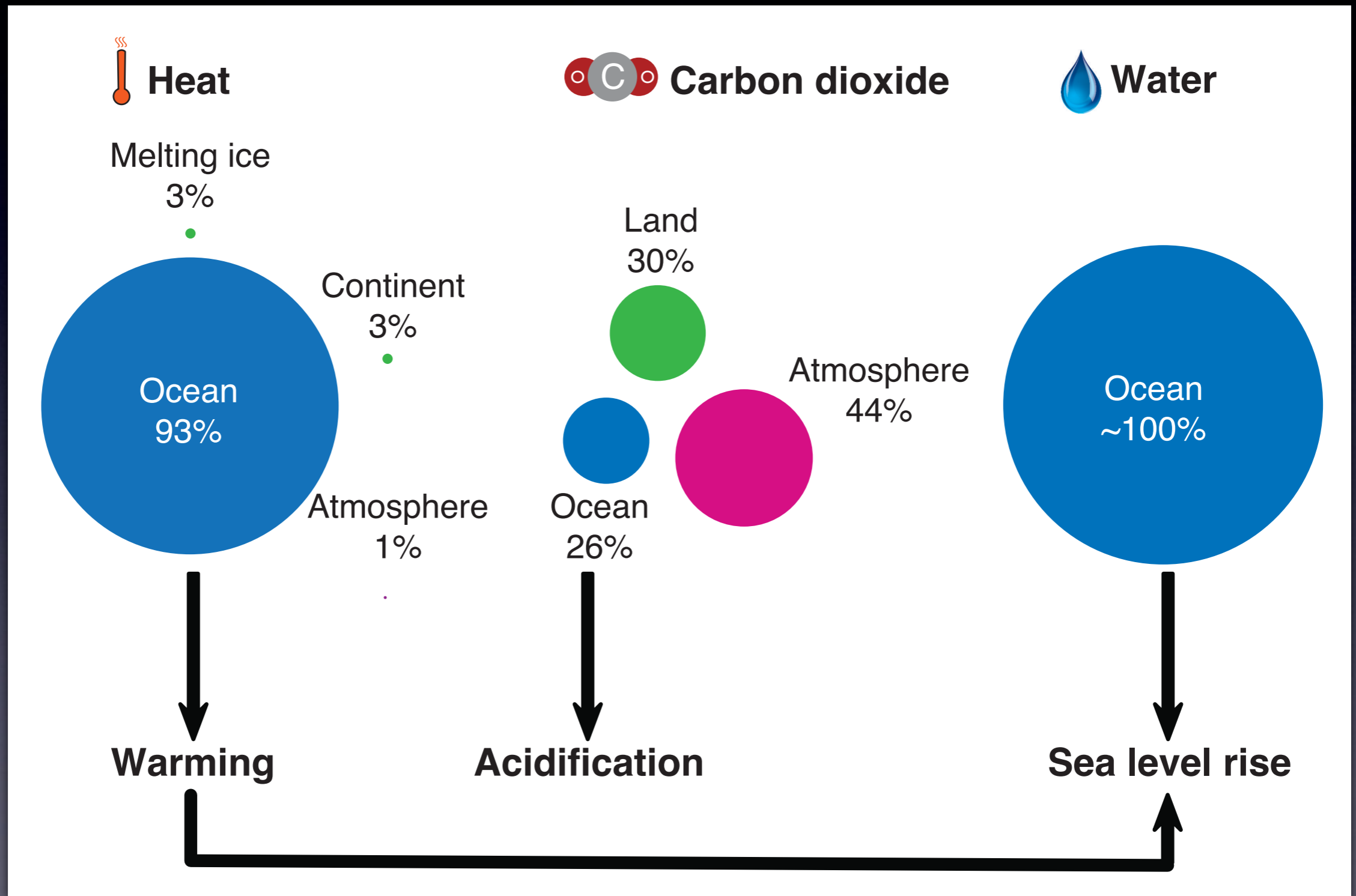
Ocean: actor and victim of climate change



Ocean: actor and victim of climate change



Ocean: actor and victim of climate change



Impacts combinés

Effets des émissions de carbone sur l'océan



PHYSIQUE ET CHIMIE

Température (surface) ¹	+0.83 °C
Acidité (unités pH) ¹	-0.11
Niveau de la mer ²	+0,19 m

ORGANISMES MARINS

Plantes à fleurs	○
Mangroves	○
Coraux tropicaux	●
Ptéroscopes	○
Bivalves	●
Krill	○
Poissons	○

SERVICES PROCURÉS

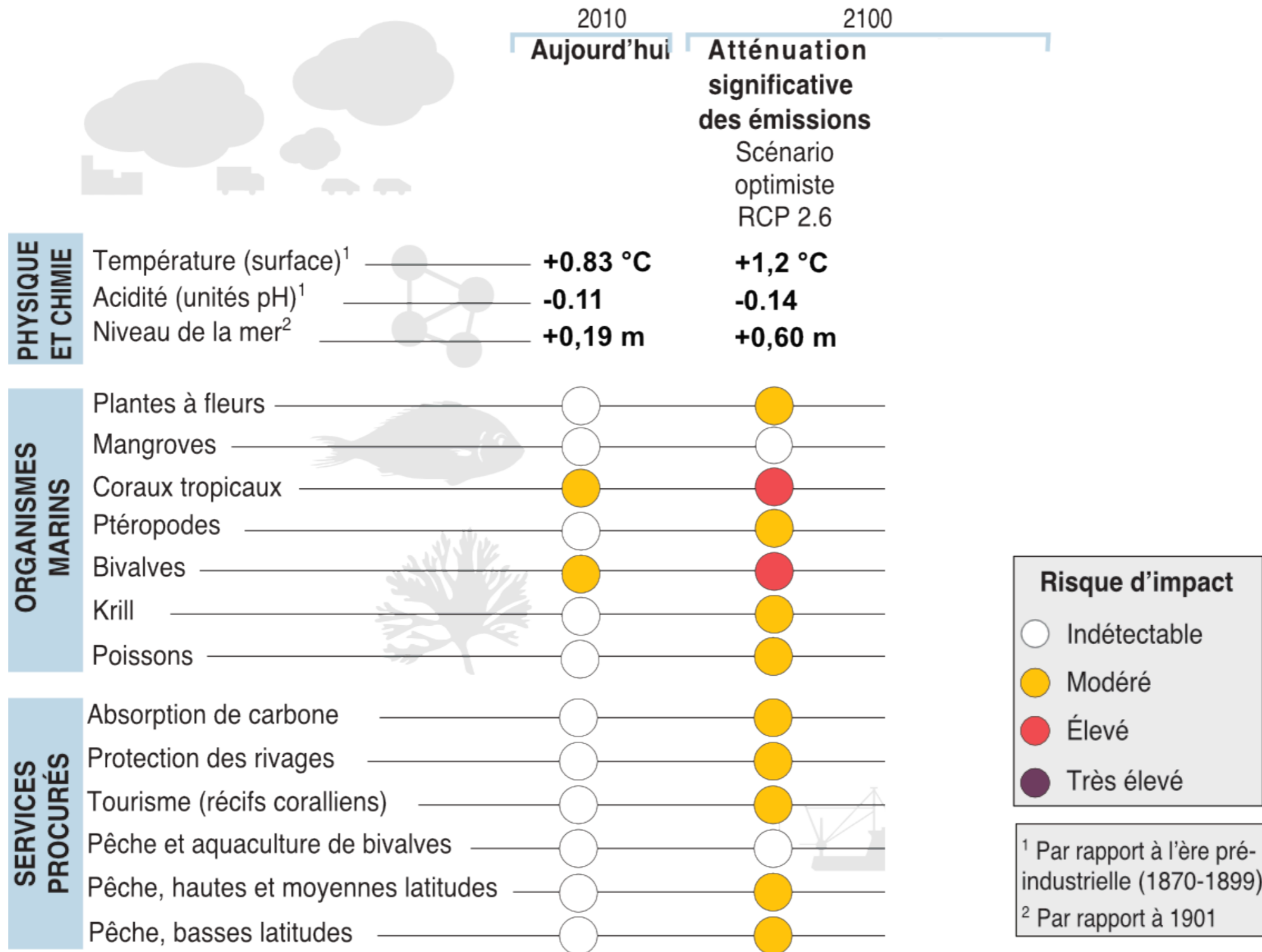
Absorption de carbone	○
Protection des rivages	○
Tourisme (récifs coralliens)	○
Pêche et aquaculture de bivalves	○
Pêche, hautes et moyennes latitudes	○
Pêche, basses latitudes	○

Risque d'impact	
○	Indétectable
●	Modéré
●	Élevé
●	Très élevé

¹ Par rapport à l'ère pré-industrielle (1870-1899)
² Par rapport à 1901

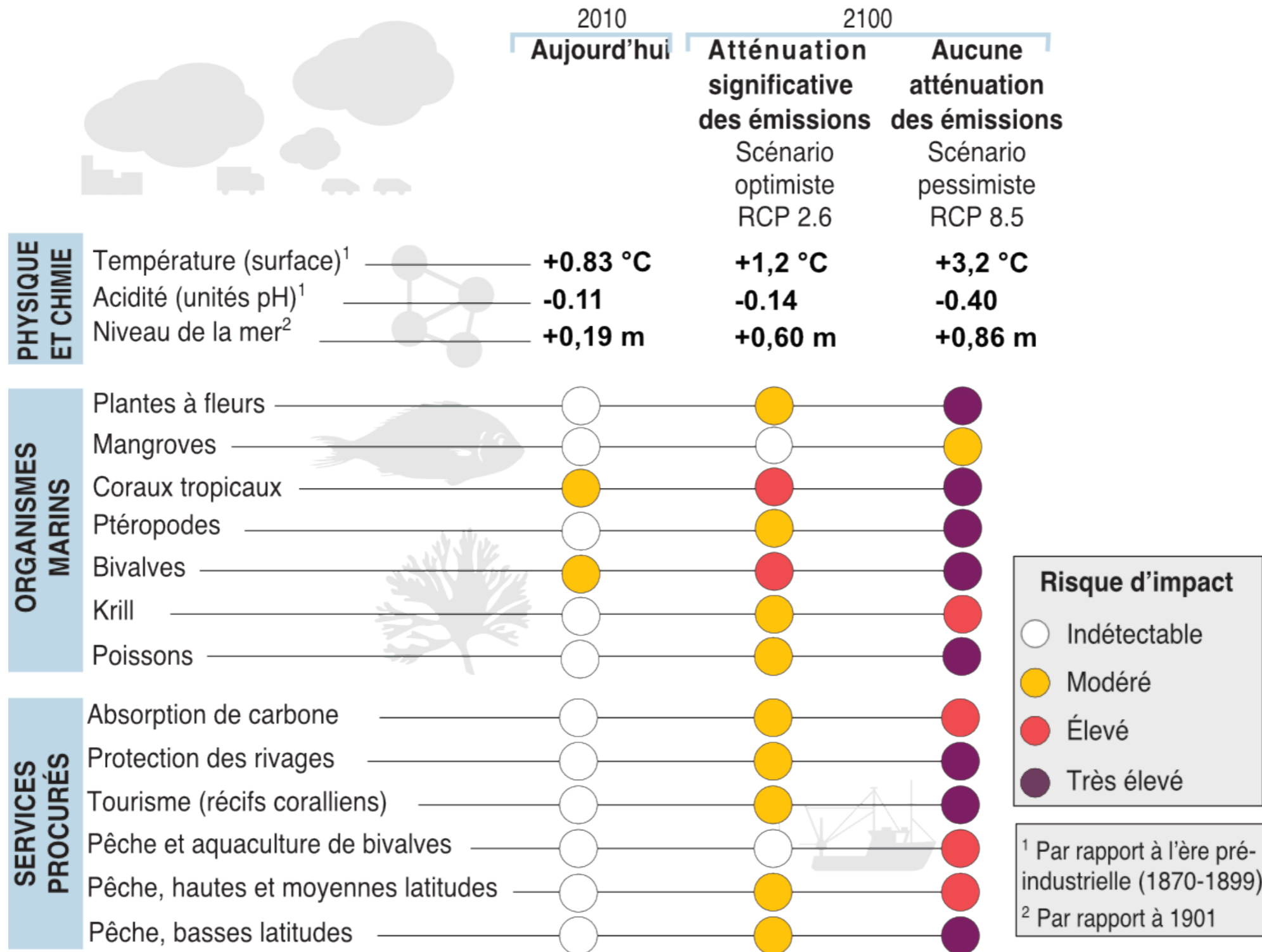
Impacts combinés

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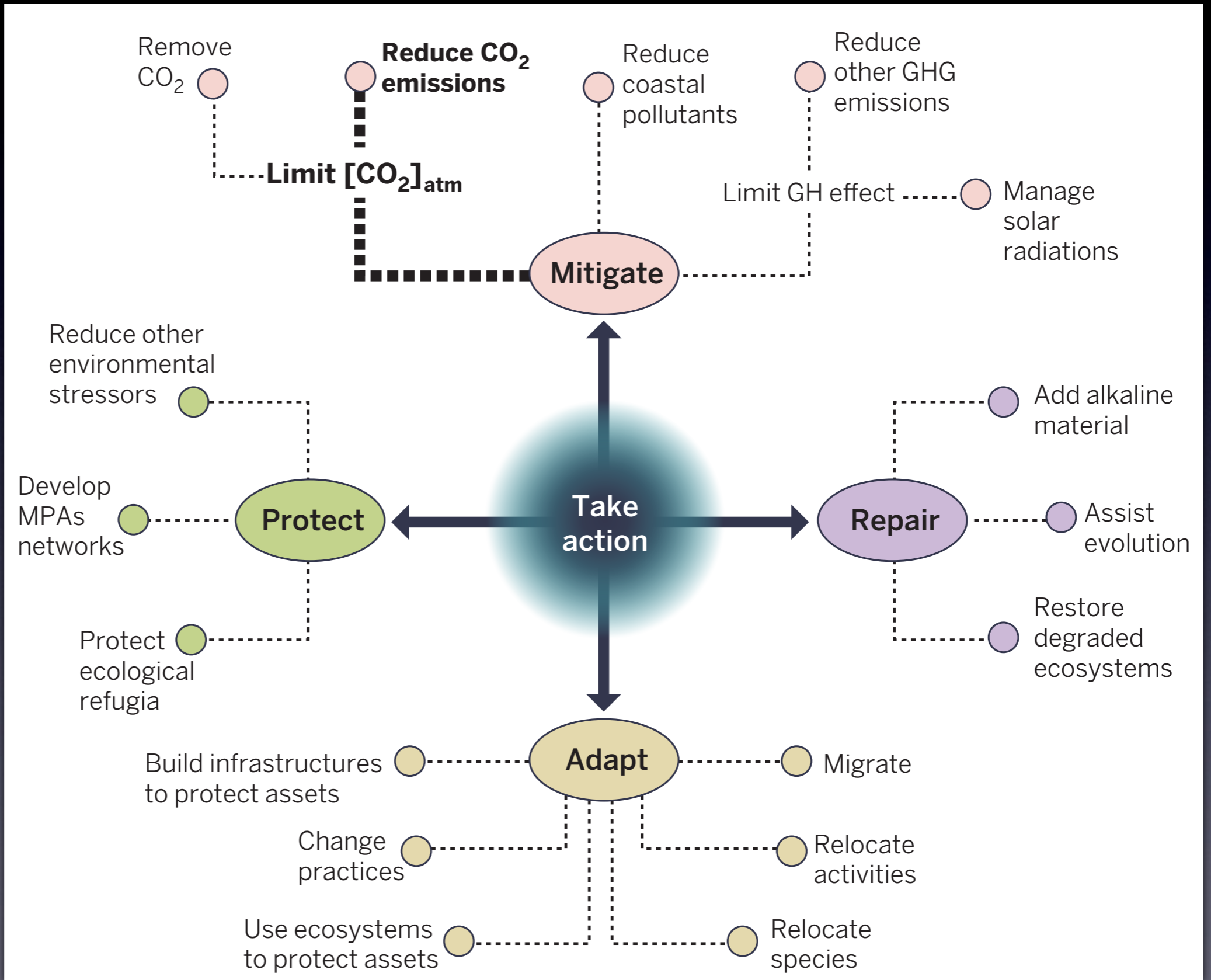


Impacts combinés

Effets des émissions de carbone sur l'océan












Solutions

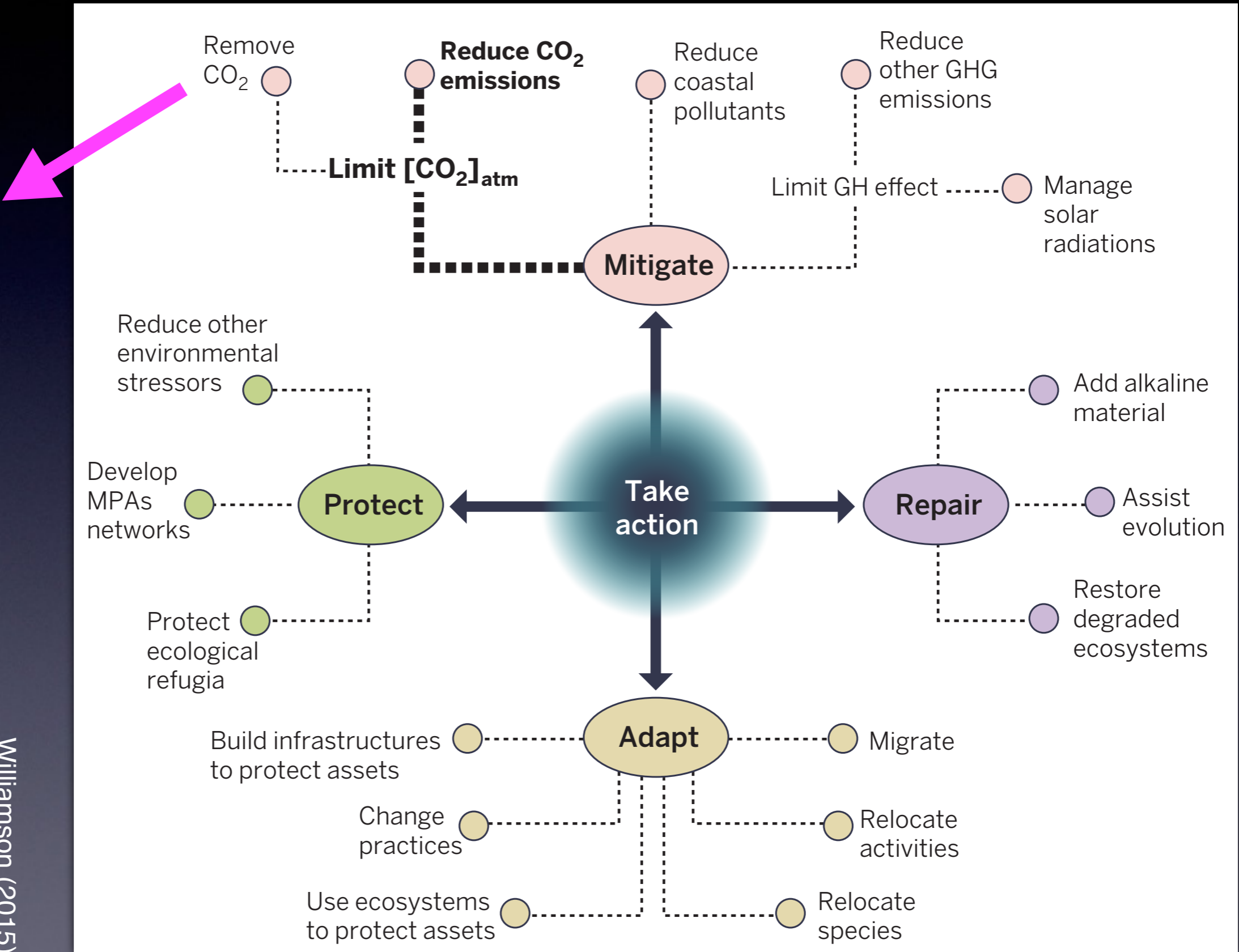


Solutions

CO₂ removal

TECHNIQUE	
	Bioenergy with carbon capture and storage (BECCS)
	Afforestation and reforestation
	'Blue carbon' habitat restoration
	Biochar
	Enhanced ocean productivity
	Enhanced weathering (using silicate rock)
	Direct air capture (DAC)
	Cloud treatment to increase alkalinity
	Building with biomass

Williamson (2015)



Gattuso et al. (2015)

4 key messages at COP21

1. Ocean strongly influences the climate system and important provider of key services
2. Impacts already detectable, high risk of impacts well before 2100, even with a low emission scenario
3. Immediate and substantial reduction of CO₂ emissions to prevent massive and mostly irreversible impacts
4. As CO₂ increases, the protection, adaptation, and repair options become fewer and less effective

IDDRI



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POLICY BRIEF

N°04/15 SEPTEMBER 2015 | CLIMATE - OCEANS AND COASTAL ZONES

Intertwined ocean and climate: implications for international climate negotiations

Alexandre K. Magnan (IDDRI), Raphaël Billé (Secretariat of the Pacific Community), Sarah R. Cooley (Ocean Conservancy), Ryan Kelly (University of Washington), Hans-Otto Pörtner (Alfred Wegener Institute), Carol Turley (Plymouth Marine Laboratory), Jean-Pierre Gattuso (CNRS-INSU, Sorbonne Universités, IDDRI)

INTRODUCTION

The atmosphere and ocean are two components of the Earth system that are essential for life, yet humankind is altering both. Contemporary climate change is now a well-identified problem: anthropogenic causes, disturbance in extreme events patterns, gradual environmental changes, widespread impacts on life and natural resources, and multiple threats to human societies all around the world. But part of the problem remains largely unknown outside the scientific community: significant changes are also occurring in the ocean, threatening life and its sustainability on Earth.

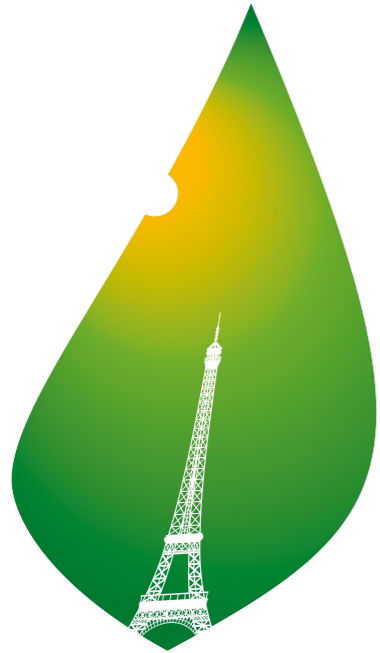
This Policy Brief explains the significance of these changes in the ocean. It is based on a scientific paper recently published in *Science* (Gattuso *et al.*, 2015), which synthesizes recent and future changes to the ocean and its ecosystems, as well as to the goods and services they provide to humans. Two contrasting CO₂ emission scenarios are considered: the high emissions scenario (also known as "business-as-usual" and as the Representative Concentration Pathway 8.5, RCP8.5) and a stringent emissions scenario (RCP2.6) consistent with the Copenhagen Accord¹ of keeping mean global temperature increase below 2°C in 2100.

1. Copenhagen Accord, *Decision 2/CP.15: Copenhagen accord* (United Nations Framework Convention on Climate Change, Geneva, 2009).

KEY MESSAGES

- Climate and ocean are inseparable: the ocean moderates anthropogenic climate change by absorbing significant proportions of the heat and CO₂ that accumulate in the atmosphere, as well as by receiving all water from melting ice.
- This climate-regulating function happens at the cost of profound alterations of the ocean's physics and chemistry, leading to ocean warming and acidification, as well as to sea level rise. These changes significantly affect the ocean's ecology (organisms and ecosystems) and eventually marine and coastal human activities (fisheries, aquaculture, tourism, health...).
- As atmospheric CO₂ increases, possible human responses become fewer and less effective.
- This scientific statement provides further compelling arguments for immediate and ambitious CO₂ emissions reduction at the international level. This conclusion applies to COP21 as well as to the post-2015 climate regime at large.

Paris Agreement



COP21 • CMP11

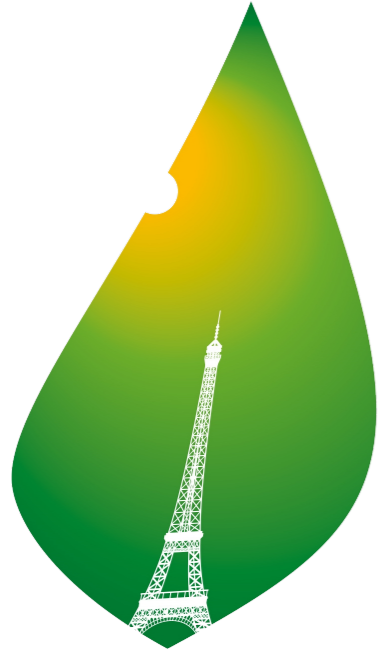
PARIS 2015

UN CLIMATE CHANGE CONFERENCE



“Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels...”

Paris Agreement



COP21 • CMP11

PARIS 2015

UN CLIMATE CHANGE CONFERENCE



1.5 °C mostly based on
ocean matters

Océan grand oublié des discussions internationales ?

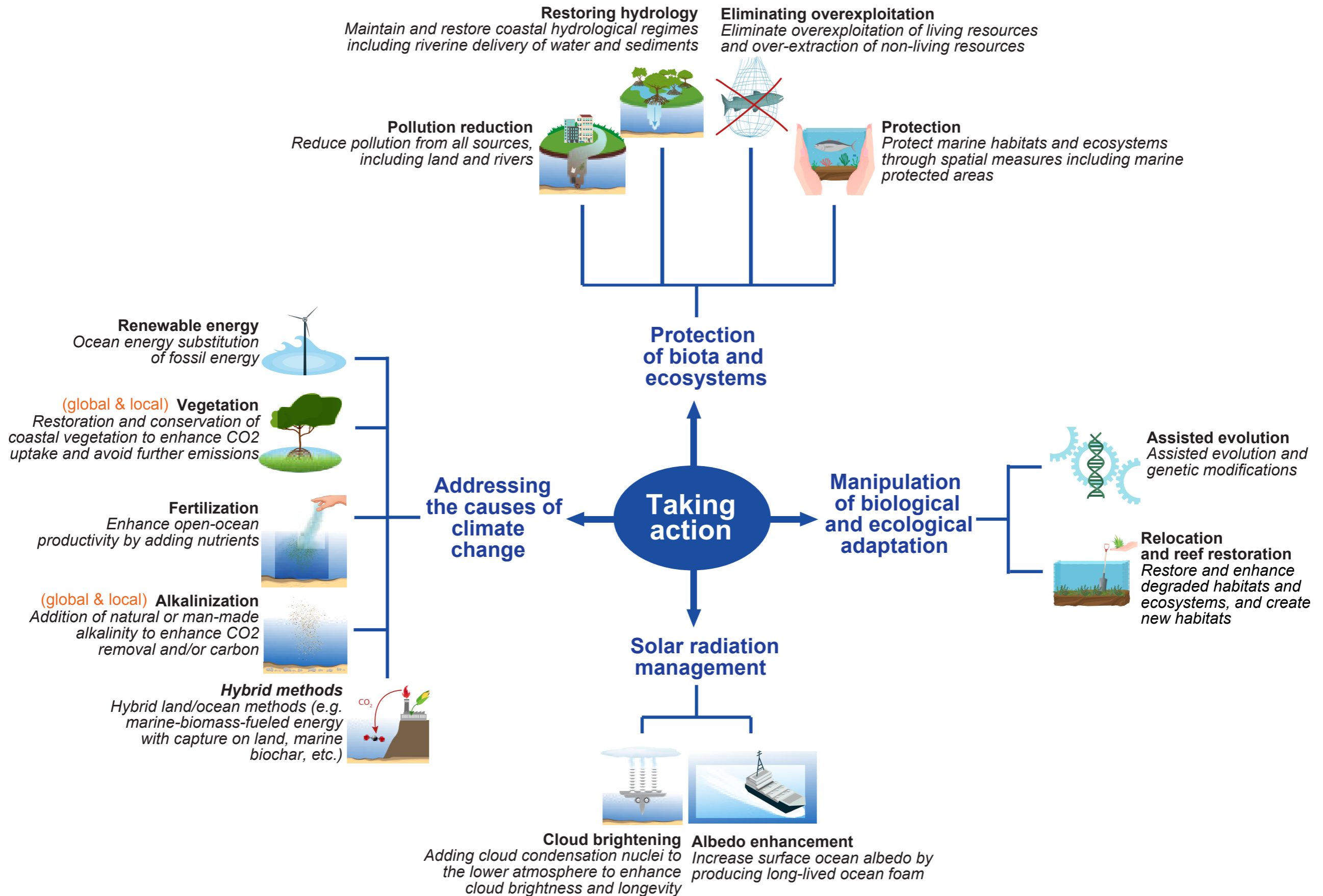
- Non (voir aussi Rochette, 2016)
- Accord de Paris : « *Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, when taking action to address climate change...* »
- Bon accord est bon pour l'océan



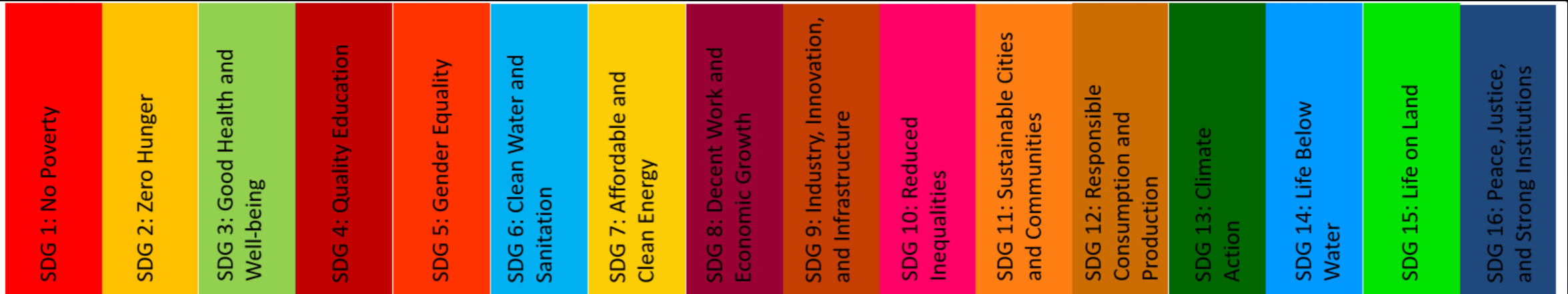
Ocean-based solutions



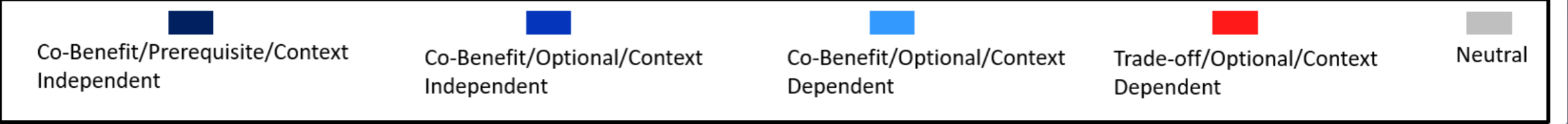
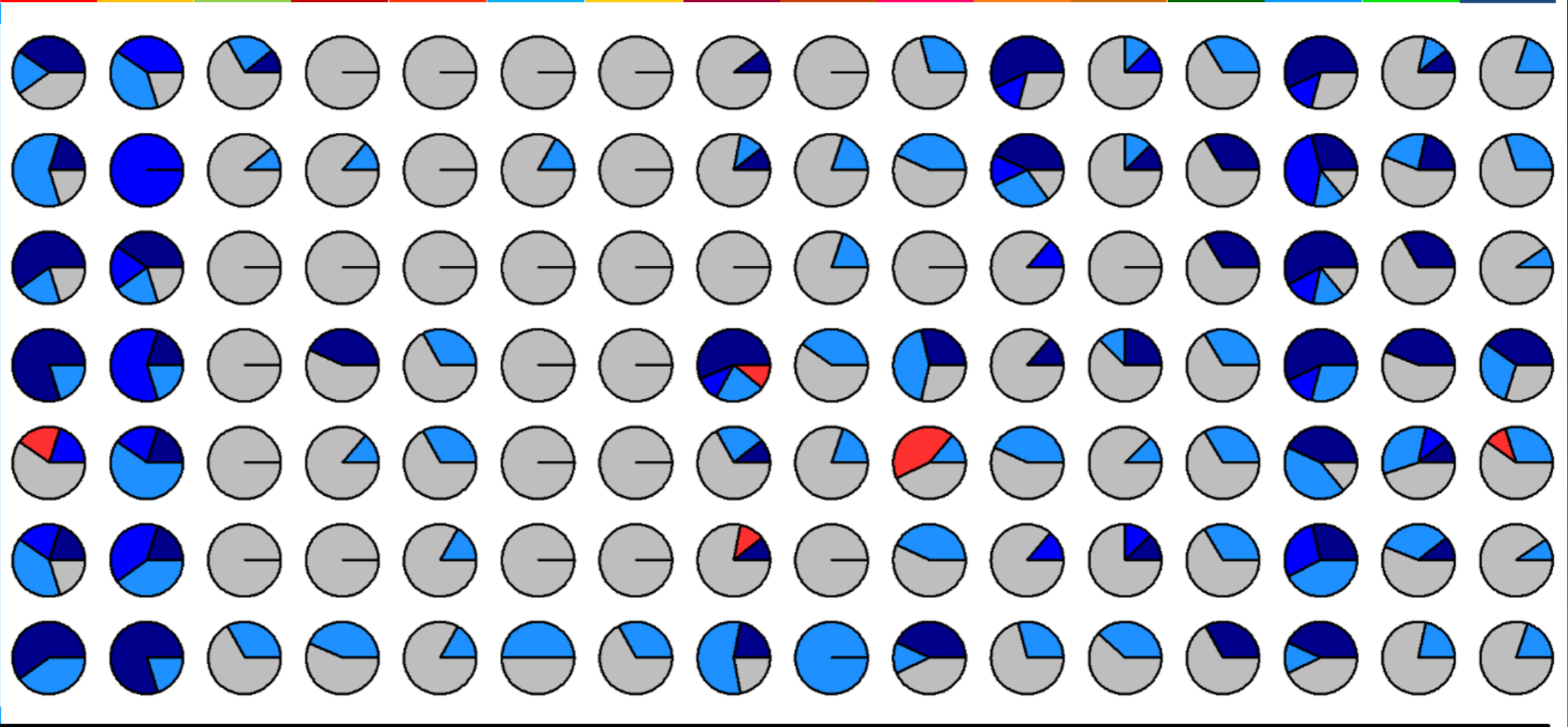
Solutions considered



SDGs



SDG 14.1: Marine Pollution
 SDG 14.2: Environmental Restoration
 SDG 14.3: Ocean Acidification
 SDG 14.4: End Overfishing
 SDG 14.5: Marine Protection
 SDG 14.6: End Harmful Subsidies
 SDG 14.7: Small Island and Developing States



More: <http://bit.ly/1M6YiS6>

Many thanks to coauthors

OCEANS 2015 INITIATIVE



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The Ocean Solutions Initiative



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PRINCE ALBERT II
OF MONACO
FOUNDATION



Fondation
VEOLIA



FONDS FRANÇAIS POUR
L'ENVIRONNEMENT MONDIAL

Objectives of The Ocean Solutions Initiative

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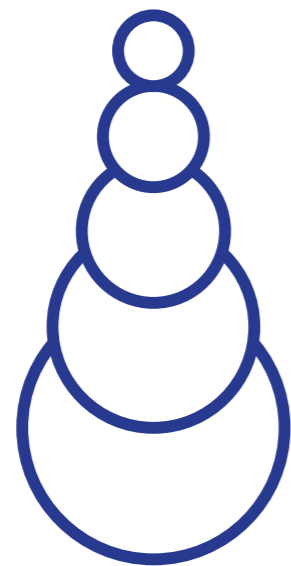
- Assess potential of ocean-based measures to:
 - reduce changes in three major climate-related drivers (ocean warming, ocean acidification, and sea-level rise) both globally and/or locally
 - reduce adverse impacts on
 - vital climate-sensitive ecosystems (coral reefs, mangroves and salt marshes, seagrass beds, and Arctic biota) and
 - ecosystem services (fin fisheries, fish aquaculture, coastal protection, and bivalve fisheries and aquaculture)

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 - ecosystem services (fin fisheries, fish aquaculture, coastal protection, and bivalve fisheries and aquaculture)
- Expert assessment based on 8 criteria:
 - environmental effectiveness
 - technological readiness
 - lead time until full potential effectiveness
 - duration of benefits
 - co-benefits
 - disbenefits
 - cost effectiveness
 - governability from an international perspective

Examples

Technological readiness



Very low

Low

Moderate

High

Very High

No data

Cost effectiveness

\$\$\$\$\$

\$\$\$\$

\$\$\$

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\$

Duration of the effects



Days/months



Years



Decades/centuries



Centuries

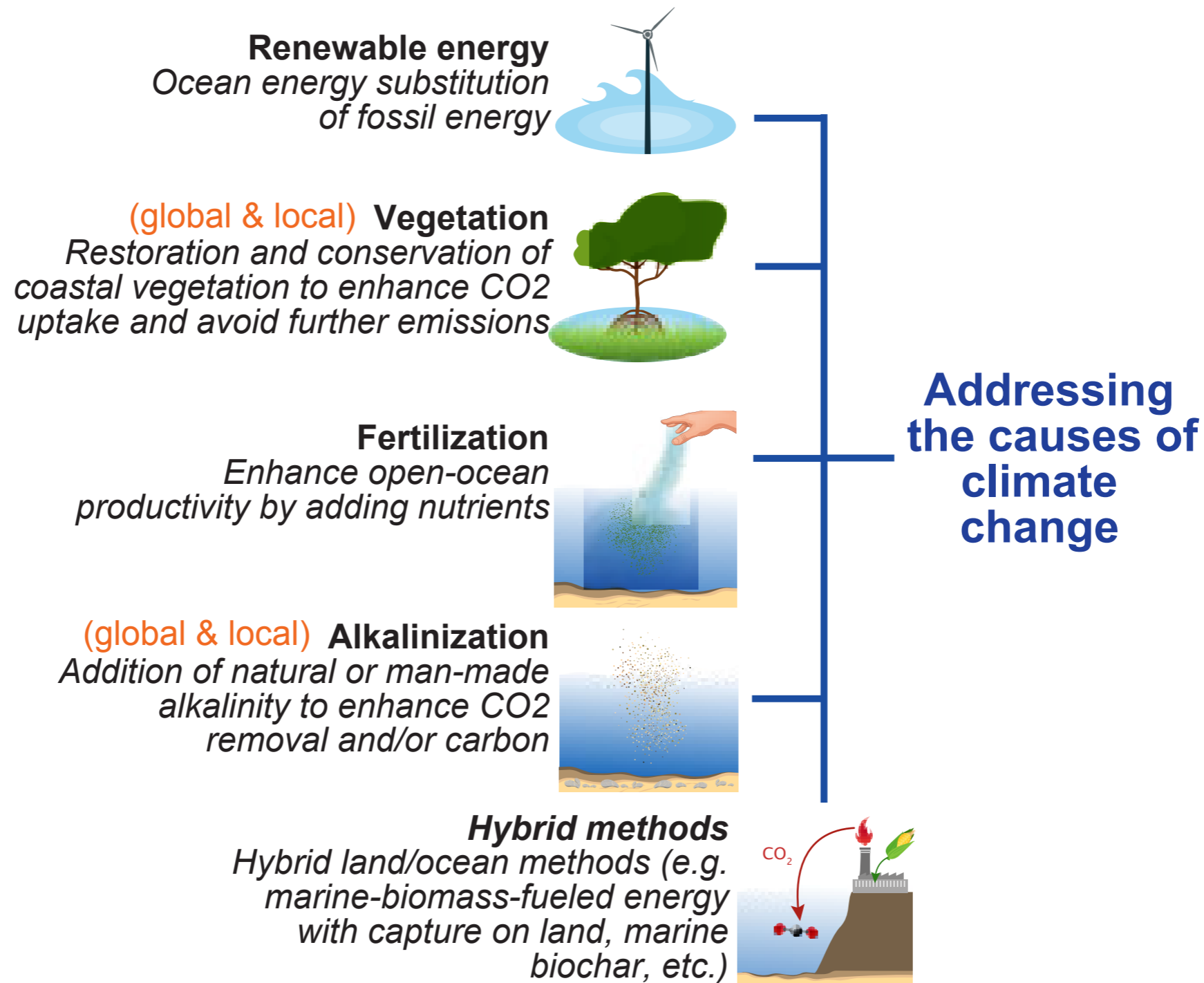


Permanent



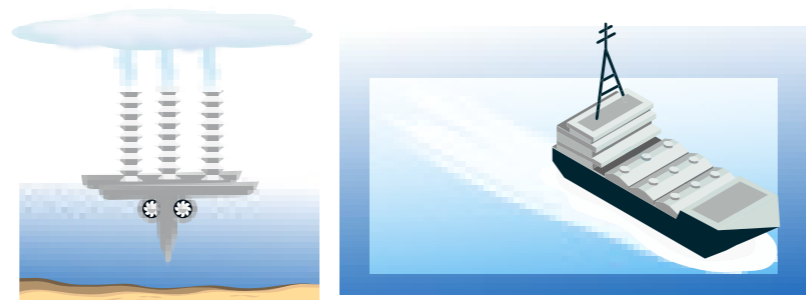
No data

Addressing the causes



Solar radiation management

Solar radiation management



Cloud brightening

Adding cloud condensation nuclei to the lower atmosphere to enhance cloud brightness and longevity

Albedo enhancement

Increase surface ocean albedo by producing long-lived ocean foam

Manipulations

Manipulation of biological and ecological adaptation

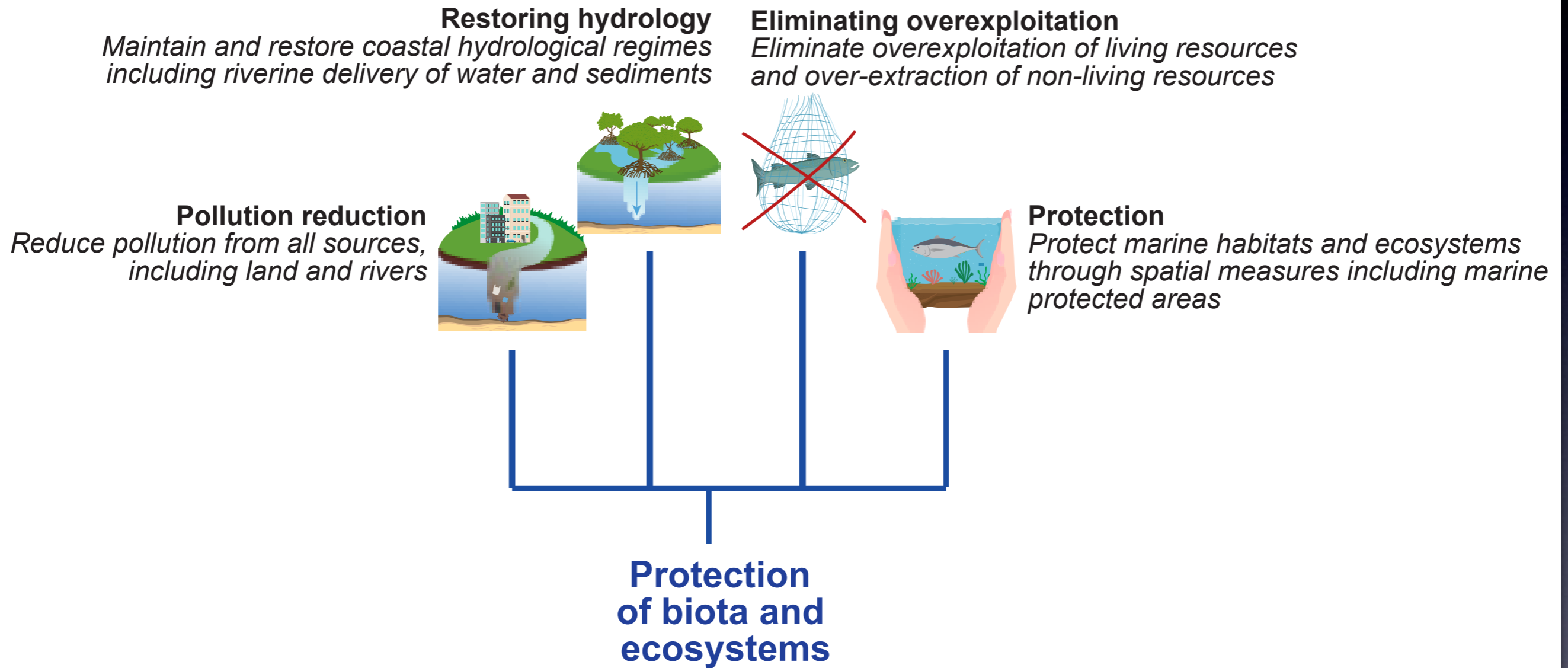


Assisted evolution
*Assisted evolution and
genetic modifications*



**Relocation
and reef restoration**
*Restore and enhance
degraded habitats and
ecosystems, and create
new habitats*

Protection

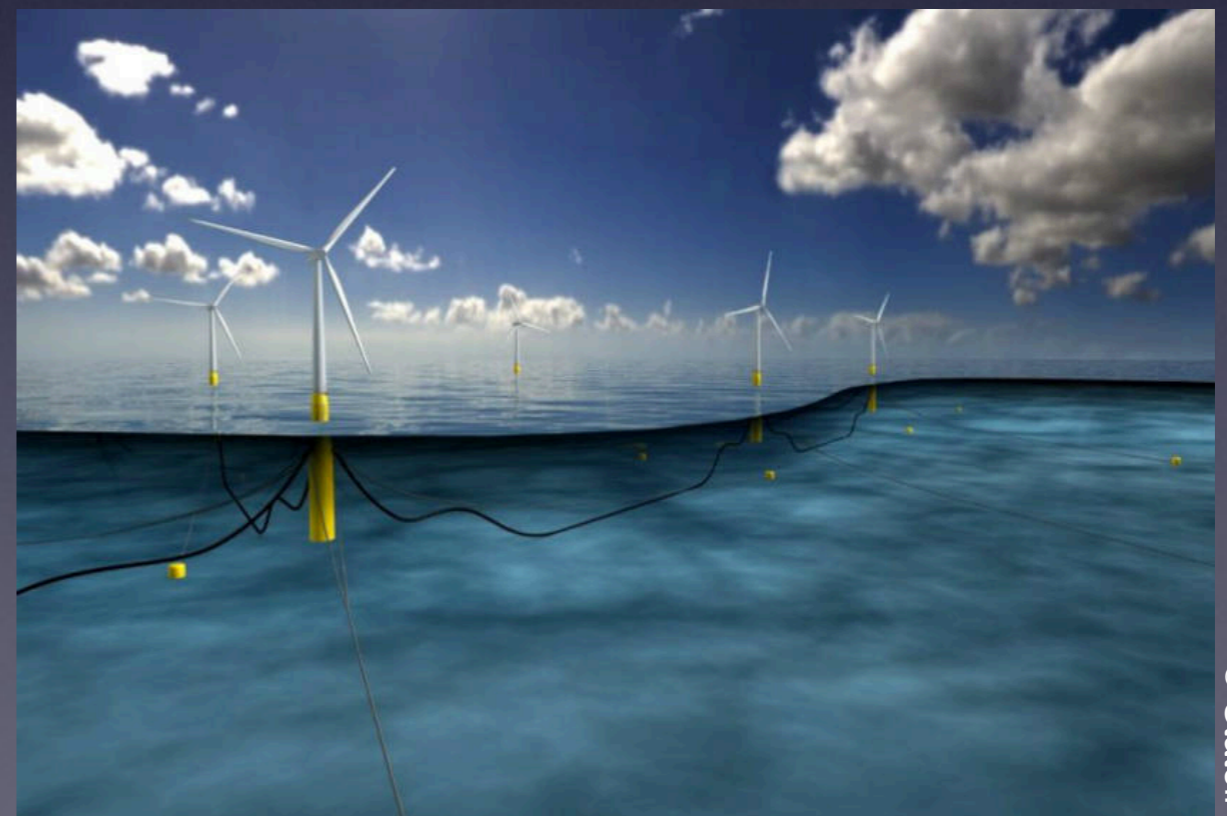


Geophysical potential for wind energy over the open oceans

- Possner & Caldeira (PNAS, 2017)
- Land: upper limit to the amount of energy that can be generated by a wind farm
- Ocean:
 - wind speeds can be as much as 70% higher than on land
 - better wind replenishment
 - upper limit considerably higher
- Wind power available in the North Atlantic could be sufficient to power the world
- Caveats:
 - theoretical calculations
 - winds aren't equally strong in all seasons
 - technologies at such a scale, much less transfer it to shore, do not currently exist
 - simulations suggest that extracting this much wind energy would have planetary-scale effects, including cooling down parts of the Arctic by as much as 13°C



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Key messages

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4. Multiple-scale action calls for a diversity of actors to be involved, which in turn requires the international community to ensure consistency in global to local action
5. Since controversies and uncertainties hamper the worldwide spread of action, scientific effort must focus on effectiveness, co-benefits, disbenefits, and costings of poorly tested as well as new and emerging measures